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THE RELATIONSHIP BETWEEN SELECTED ECONOMIC AND DEMOGRAPHIC MEASURES AND EMPLOYMENT/SPECIALIZATION

by

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Three recent trends have contributed to changes in sectoral distribution and growth of employment in rural and urban areas, and to a subsequent need for new economic development strategies and policies. First, the population turnaround which began about 1970 resulted in a reversal of net migration from urban to rural counties [1,8]. Second, manufacturing employment grew by an annual rate of 4.6 percent in rural counties during the 1960's, more than double the rate of increase in metropolitan counties [21, p.11]. Manufacturing now provides for about 25 percent of all employment in the nonmetropolitan areas of the nation [18]. Finally, growth of employment in the service performing sectors of both metropolitan and nonmetropolitan areas is more rapid than manufacturing employment growth. Between 1962 and 1978, the employment increase in the service performing sectors of both metropolitan and nonmetropolitan areas was 78 percent [7]. By 1980, employment in the service performing sectors accounted for 65 percent of all U.S. employment in 1980 [19]. The net result of these changes in the North Central Region is that the distribution of employment by sector in metropolitan and nonmetropolitan counties had become very similar by the early 1970's (Table 1).

Deliberations of the North Central Research Committee on Employment and Income on Small Farms and in Rural Communities (NCR-108) from 1978 to 1981 showed considerable concern about the need to define "prototype counties" for which economic development strategies or policies could be

TABLE 1: Distribution of Employment by Sector, Metropolitan and Nonmetropolitan Counties, North Central Region 1974[a/]

Sector	Percent of Total Employment by Sector	
	Metropolitan	Nonmetropolitan
Agriculture	1.4	12.3
Manufacturing	30.2	23.0
Trade	19.3	18.7
Services	20.3	21.2
Business and Finance	7.5	4.5
Construction	4.6	5.4
Public Administration	4.2	3.6
Transportation	6.3	5.3
Mining	0.3	1.1

Source: [22]

a/ County employment percentages are weighted by county population.

developed. Once developed, the strategy for each prototype would be widely applicable to other counties of that type. More recently, Deavers discussed the same need to classify counties for policy purposes at the Community Economic Development Strategies Conference in Omaha in March, 1983 [16, pp. 157-170].

The general objective of this study is to examine whether counties can be classified into a "usefully small" number of prototype counties. The sectoral employment distribution of each county is used to classify each county.[1/] The relationship between employment distribution and location and community characteristics is then examined using a discriminant model. The empirical analysis is carried out with 1970 data for the North Central Region of the United States.[2/]

The results generally show that there are statistically significant relationships between employment distribution and location and community characteristics. However, the ability to classify counties into mutually exclusive prototypes is limited.

A Model of County Economic Specialization

There are several theories of economic growth, each with a different set of variables hypothesized to determine economic growth and specialization. Location theory, growth center theory, export base theory, income-expenditure theory, natural resource theory and neoclassical theory of economic growth were used to identify the important variables in the development process. Location theory proposes that several geographic and demographic factors influence the volume and type

of economic activity in a county [9,23].[3/] These include the accessibility of the county in terms of the availability and quality of transportation, and the extent of agglomeration economies within a county as measured by population and production concentration. Growth center theory reinforces location theory by stressing the importance of urbanization in area economic growth [6].

In addition to locational advantages, the economic activities of a county are expected to be those activities in which the county has a comparative advantage in production. The extraction of locally endowed natural resources, according to natural resource theory, creates economic activities in a county [17]. Similarly, export base theory emphasizes the importance of the export sector in determining the level of income and employment through the multiplier process [10,12]. The income expenditure model relates the growth of a county to various exogenous influences such as government expenditures and autonomous investments [15].

All the above factors together with county population attributes such as the quality of labor force and income level are hypothesized to have a relationship with the economic specialization of a county. The economic specialization relationship is specified as

(1) Economic Specialization = f (location and county characteristics).

Economic Specialization

The location quotient was used to define economic specialization of the county.[4/] The location quotient, which is also called the

coefficient of localization or specialization, measures the degree to which a county is specialized in a given activity of the nation [10]. If a county has a high concentration of employment in a certain activity relative to the average prevailing in the nation, that county is assumed to have a comparative advantage in that activity.

Mathematically, the location quotient (LQ) for industry i in county j is

$$LQ_{ij} = \frac{e_{ij}}{E_j} \Big/ \frac{e_{in}}{E_n} \tag{2}$$

where e_{ij} is the employment of industry i in county j, E_j is total employment in county j, e_{in} is national employment in industry i, and E_n equals total national employment. If LQ_{ij} is greater than 1, this is an indication of relative specialization in the county.

Economic specialization in a county is defined as the industry or industries with location quotient(s) greater than one. The empirical specification of economic specialization is presented in the next section.

Factors Influencing Economic Specialization

The basic elements in a firm's location decision as espoused by location theory are resources, markets and transportation services. The availability and quality of local transportation services reflect the relative accessibility of a community. Manufacturing industries are more likely than other industries to take advantage of superior transportation services. It is hypothesized that the relative quality

of transportation services as measured by the presence of an interstate highway within a county is positively related to manufacturing specialization. Other measures were not used because nearly all counties have railroads and an airport (strip), and mileage or quality data would be difficult to assemble if available at all.

Businesses that produce or handle goods for final consumption usually locate to minimize distribution costs. Industries in consumer services which trade in finished consumer goods and the later stages of consumer goods manufacture are all oriented towards the consumer market. The degree of urbanization and county population are hypothesized to be indexes of potential sales in an area. Further, the degree of urbanization and county population are hypothesized to be proxies for the external economies which attract manufacturing firms into a community. It is hypothesized that the degree of urbanization and county population are positively related to trade, services and manufacturing specializations.

For some industries, labor supply is the major input. An abundant supply of low cost unskilled or semi-skilled labor creates a strong attractive force for certain industries, especially manufacturing and service establishments. The percent of a county's population in the working age, given county population, is a measure of the available labor force. It is hypothesized that the larger the working age population of a county of a given population, the more likely is the county to specialize in labor intensive manufacturing and service industries.

As a county's income increases, given population, the local markets for goods and services expand. As per capita income increases, the demand for products with high income elasticities of demand increases

relative to those with lower income elasticities. It is expected that higher per capita income will attract relatively more manufacturing and service oriented industries into a community, and be positively related to manufacturing and service specialization.

Taxes are considered as part of the operation costs to firms; the lower the taxes, the lower the operating costs of the firm. Federal taxes are not expected to have an impact on location decisions by firms because they are the same in all 50 states [9]. However, state and/or local taxes become an important associated factor for certain industries. The property tax is the largest state or local tax in most counties. Counties with high property taxes are expected to have relatively less capital intensive industry such as manufacturing, but may have relatively more extractive industry such as agriculture because of immobile natural resources which can be exploited. In this study, per capita property taxes are used to measure the level of local property taxes.[5/] The relationship of per capita property tax with agriculture and/or mining specialization is expected to be positive, and with manufacturing is expected to be negative.

As a county becomes more urbanized, the likelihood of the county being agriculturally oriented decreases. It is hypothesized that the degree of urbanization is negatively related to agricultural specialization.

In summary, it is hypothesized that the presence of an interstate highway, the degree of urbanization, population, working age population, and median income are positively related to manufacturing specialization.

Agricultural and/or mining specialization are hypothesized to be positively associated with per capita property taxes and negatively associated with population and degree of urbanization. Trade and services are hypothesized to be positively related to population, degree of urbanization, median income, and working age population.

Definition of Employment Structure

Through the U.S. Bureau of Economic Analysis, the 1970 industry employment of nine one-digit SIC industries for every county in the North Central region was obtained.[6/] The industries are (1) Agriculture (including forestry and fishing), (2) Mining, (3) Manufacturing, (4) Construction, (5) Trade, (6) Transportation, Communications and Utilities, (7) Finance, Insurance and Real Estate, (8) Services, and (9) Government. To classify a county as having specialization in an industry under the location quotient criterion, the ratio of the percent of county employment in the particular industry to the percent of national employment in the industry has to be greater than one.

Using the location quotient criterion, a substantial number of counties were found to have location quotients greater than one in more than one industry. Industries were aggregated based on the distribution of counties having location quotients greater than one a combination of industries. Industries were also aggregated because the number of counties that have location quotients greater than one in particular industries were very few. Trade and construction were aggregated as one industry group because 69 counties out of 200 in trade and 186 in construction had location quotients greater than one in both industries.

Mining and transportation, communications and utilities were aggregated because 42 counties had location quotients greater than one out of 76 in mining and 163 in transportation, communications and utilities. Finance, insurance and real estate and services were combined as one industry group because they are service oriented.

This aggregation resulted in the identification of six predominant industry groups: Agriculture (1.4); Manufacturing (22.3); Trade and Construction (22.9); Mining, Transportation, Communications and Utilities (6.0); Finance, Insurance Real Estate and Services (20.1); and Government (17.3), where the numbers in parentheses are the national percentages of employment for each industry, i.e., the denominators of the location quotients.[7/] The distribution of counties by the industry groups is presented in Table 2. Out of the 1053 counties in the North Central region, 328 have specialization in agriculture only, i.e., only the location quotient for agriculture was greater than one, while 98 counties specialized in manufacturing only. Fifty-one of the counties specialized in government only. In the aggregated industries, 13 counties have specialization in trade and construction, 12 in mining, transportation, communications and utilities, and 3 in finance, insurance, real estate and services. Eighteen counties had no specialization in any industry group, i.e., did not have a location quotient greater than one in any industry.[8/]

A number of counties had specialization in two or more of the six industry groups, i.e., had location quotients greater than one in two or more industries. As shown in Table 2, 79 counties had specialization

TABLE 2: Distribution of Counties by Industry Group, North Central Region, 1970* (Location Quotient Criterion)

	Agriculture	Manufacturing	Trade and Construction	Mining/ Transportation/ Communications/ Utilities	Finance/ Insurance/ Real Estate/ Services	Government	No Specialty	Total No. of Counties
Agriculture	328	79	54	67	19	246	0	726
Manufacturing		98	40	50	17	36	0	268
Trade and Construction			13	36	33	23	0	126
Mining/Transportation/ Communications/Utilities				12	28	37	0	147
Finance/Insurance/ Real Estate/Services					3	16	0	61
Government						51	0	352
No Specialty							18	18

* The total number of counties listed sums to greater than 1053 because several counties have location quotients greater than one in more than two industry groups.

in both agriculture and manufacturing; 54 counties specialized in agriculture as well as trade and construction; 67 counties specialized in agriculture and mining, transportation, communications and utilities. Nineteen counties specialized in agriculture and finance, insurance, real estate and services, while 246 counties specialized in agriculture as well as government. Some of the counties listed with specialization in two industry groups in Table 2 also had location quotients greater than one in a third or a fourth industry. This is why there are more counties with each industry group in the body of the table than shown in the final column. For example, a total of 726 counties have agricultural specialization, but 793 are shown in the body of the table. The remaining 67 are accounted for by counties with specialization in three or more industries, i.e., a county with agriculture, manufacturing and government specializations would be listed in the agriculture row under manufacturing and under government.

In Table 3, government specialization is deleted. Of 352 counties with a government location quotient greater than one, only 51 had specialization in government only, while 246 also had a specialization in agriculture (Table 2). Government activity was found to be distributed about proportionately throughout the other industry groups. Government specialization, therefore, did not appear to be a useful criterion for distinguishing among counties.

The deletion of government specialization in Table 3 results in an increase in the number of counties with single industry specialization. The agriculture specialization increases by 207 from 328 in Table 2 to

TABLE 3: Distribution of Counties by Industry Groups (Government Excluded), North Central Region, 1970*
(Location Quotient Criterion)

	Agriculture	Manufacturing	Trade and Construction	Mining Transportation Communications/ Utilities	Finance/ Insurance/ Real Estate/ Services	No Specialty	Total No of Counties
Agriculture	535	79	54	67	19	0	726
Manufacturing		122	40	50	17	0	268
Trade and Construction			19	36	33	0	126
Mining/Transportation/ Communications/Utilities				23	28	0	147
Finance/Insurance/ Real Estate/Services					8	0	61
No Specialty						69	69

* The total number of counties listed sums to greater than 1053 because several counties have location quotients greater than one in more than two industry groups.

535 in Table 3. The remaining 39 counties of the 246 agriculture-government counties from Table 2 are absorbed in the off-diagonal entries. The number of counties with specialization in manufacturing only increases from 98 in Table 2 to 122 in Table 3. In a similar manner, the number of counties with specialization in the three remaining industry groups increases. Of the 69 counties with No Specialty, 51 have government specialization (see Table 2).[9/]

From the distribution of counties by industrial groupings presented in Table 3, six basic economic specializations were adopted for this study: (1) Agriculture: counties with a location quotient (LQ) greater than one for agriculture (forestry and fishing) only; (2) Manufacturing: counties with LQ greater than one for manufacturing only or for agriculture and manufacturing only; (3) Manufacturing/Other: counties with LQ greater than one for manufacturing and one or more of the other industries; (4) Agricultural/Other: counties with LQ greater than one for agriculture and one or more of the other industries; (5) Nonagriculture/Nonmanufacturing: counties with LQ greater than one in some combination of trade and construction; or mining, transportation, communications and utilities; or finance, insurance real estate and services, and (6) No Specialty: counties without a location quotient greater than one in any industry. The number and percent of counties falling into the six economic specializations are presented in Table 4.

Relationship of Selected Characteristics to Economic Specialization

The distribution of counties by metropolitan status, proximity to SMSA and the presence of an interstate highway is given in Table 5. Out

TABLE 4: Number and Proportion of Counties Falling in Designated Economic Specialization, North Central Region, 1970

Economic Specialization	No. of Counties	Proportion of Counties
Agriculture	535	50.81
Manufacturing	194	18.42
Manufacturing/Other	74	7.03
Agriculture/Other	112	10.64
Nonagriculture/Nonmanufacturing	69	6.55
No specialty	69	6.55
Total	1053	100.00

TABLE 5: Distribution of Counties by Metropolitan Status, Proximity to SMSA and Presence of Interstate Highway, North Central Region, 1970

Economic Specialization	No. of Counties	SMSA Counties	Non-SMSA Counties	Adjacent Counties	Non-Adjacent Counties	Counties with Interstate Highway	Counties without Interstate Highway
Agriculture	535	9 (1.2%)	526 (57.9%)	127 (46.4%)	399 (62.9%)	81 (28.4%)	454 (59.1%)
Manufacturing	194	49 (33.8%)	145 (15.9%)	88 (32.1%)	57 (9.0%)	75 (26.3%)	119 (15.5%)	
Manufacturing/ Other	74	42 (28.9%)	32 (3.5%)	15 (5.5%)	17 (2.7%)	45 (15.8%)	29 (3.8%)
Agriculture/ Other	112	7 (4.8%)	105 (11.6%)	20 (7.3%)	85 (13.4%)	31 (10.9%)	81 (10.5%)
NonAg-NonMfg	69	27 (18.6%)	42 (4.6%)	8 (2.9%)	34 (5.4%)	32 (11.2%)	37 (4.8%)
No Specialty	69	11 (7.6%)	58 (6.4%)	16 (5.8%)	42 (6.6%)	21 (7.4%)	48 (6.3%)
North Central Region	1053	145	908	274	634	285	768

of the 1053 counties in the North Central region, 145 (14 percent) are SMSA counties while 908 are non-SMSA counties. The majority of the non-SMSA counties (634) are not adjacent to any SMSA county. The distribution of counties by the presence of an interstate highway shows that 768 (73 percent) of the 1053 counties did not have an interstate highway within their borders in 1970.

The distribution of economic specialization among SMSA counties indicates that the predominant specializations in these counties are manufacturing followed by manufacturing/other and then nonagriculture/nonmanufacturing. For the 908 non-SMSA counties, 526 (88 percent) are agriculture in specialization. About 16 percent of non-SMSA counties have manufacturing specialization and 12 percent are agriculture/other in specialization.

The distribution of economic specialization among the 274 non-SMSA counties that are adjacent to SMSA counties indicates that the predominant specialization in these counties is agriculture, followed by manufacturing and then agriculture/other. For the 634 non-SMSA counties that are not adjacent to any SMSA county, the predominant specializations are agriculture, agriculture/other and manufacturing.

In summary, most of the counties in the North Central region are rural or non-SMSA. These rural counties have all types of economic activities, although agriculture is the predominant industry with a location quotient greater than one. The economic specializations that seem to be predominant in metropolitan counties are manufacturing or a combination of manufacturing and other economic activities. Finally,

columns 7 and 8 of Table 5 show that a greater portion of the counties with an interstate highway had specialization in nonagriculture activities.

Analysis of Economic Specialization

In this section discriminant analysis is used to explain the association between locational and community characteristics of a county and a set of classification variables which define the six types of economic specialization. The purpose of discriminant analysis is to assign an unknown object, on the basis of a set of n independent variables on that object, into two or more exclusive and exhaustive groups [5]. Thus discriminant analysis linearly combines independent variables (locational and community characteristics) so that the groups (the six types of economic specialization) are forced to be as statistically distinct as possible. The linear combinations of the independent variables are called discriminant functions. Linear discriminant functions are derived based on the assumption of equal within group variances.[10/] The maximum number of unique discriminant functions that can be derived is equal to the number of groups less one or the number of independent (discriminating) variables, if there are more groups than variables [3].

The form of discriminant equation used to analyze the relationship between economic specialization and locational and community variables is

$$(3)\quad D_{ig} = a_1 pURB_{ig} + a_2 POP_{ig} + a_3 RPOP70_{ig} + a_4 INC70_{ig} + a_5 TAX_{ig} + a_6 ACC_{ig}$$

where D_{ig} is the score for county i in economic specialization category g, i = 1, ... n_g, g = 1 ..., G; pURB is the proportion of the resident population in a county classified as urban in 1970; POP is the 1970 population of a county; RPOP70 is the proportion of the resident population in a county between the ages of 16 and 64 years in 1970; INC70 is the median family income in a county in 1970; TAX is per capita property tax in 1970, and ACC is 1 for counties with an interstate highway in 1970 and 0 otherwise.[11/] The a's are the coefficients of the discriminating variables, n_g is the number of counties in economic specialization category g, and G is the number of economic specialization categories. The economic specialization categories are (1) Agriculture, (2) Manufacturing, (3) Manfacturing/Other, (4) Agriculture/Other, (5) Nonagriculture/Nonmanufacturing, and (6) No specialty.

Group separation is accomplished on the basis of the divergence of group means (centroids) on the respective discriminant functions. The group mean, $\bar{D}_g$, is the sum of the a's times the mean of each variable for group g. Groups with relatively similar centroids on a given discriminant function cannot be uniquely distinguished from each other on that function. The coefficients (a's) are derived so that the means (centroids) of each group (economic specialization) on each function are as different as possible.[12/]

With six groups, there are five discriminant functions. The eigenvalues and the associated canonical correlations are presented in Table 6 in order of descending magnitude. To get a measure of the relative discriminating power in a function, eigenvalues are converted into

TABLE 6: Eigenvalues and Measures of Importance of Discriminant Functions

Discriminant Function	Eigen-value	Relative Percentage	Cumulative Percentage	Canonical Correlation
I	0.7919	77.73	77.73	0.6647
II	0.1172	11.50	89.24	0.3238
III	0.0678	6.65	95.89	0.2519
IV	0.0405	3.98	99.87	0.1974
V	0.0013	0.13	100.00	0.0363

relative percentages. Function I contains 77.73 percent of the total discriminating power in this system of equations. The fifth function contains only 0.13 percent. The canonical correlation coefficients summarize the degree of relatedness between the groups and the discriminant functions [3, p. 35]. The high canonical coefficient (0.6647) found for the first function also indicates that a strong relationship exists between the groups (economic specializations) and the first function. The fifth function has a low value which suggests a weak association.

The percentages in Table 6 reveal that over 99 percent of the discriminable variance between the categories of economic specialization can be represented by only four functions of the six variables. Consequently, only four functions are used in the following discussion.

Interpretation of Discriminant Functions

Standardized discriminant function coefficients (a_{kg}) indicate the relative magnitude of each variable's impact in the function. The sign of each coefficient shows the direction of the relationship. To improve the interpretability of the estimated discriminant functions, the variables are rotated in the discriminant function space such that the associated coefficients tend to point towards groups having the largest means (centroids) and away from groups having the lowest means on a given function [11, pp. 31-32].

The rotated coefficients and the group centroids on each of the four discriminant functions are presented in Table 7. The group centroids in function I indicate that the function is primarily able to

TABLE 7: Discriminant Analysis of Economic Specialization Classification by Locational and Community Characteristics, North Central Region, 1970

Locational and Community Characteristics	Rotated Standardized Discriminant Function Coefficients			
	Function I	Function II	Function III	Function IV
pURB	1.0574*	-0.4721	-0 1833	-0.1872
INC70	-0.0446	1.0922*	-0 1602	-0.4233
TAX	0.1750	-0.5436*	-0.0638	-0.2226
POP	-0.0194	0.0037	1 0079*	-0.0004
ACC	0.0410	-0 0985	0.1968*	0.1113
RPOP70	-0.1059	0.0938	-0.0410	1.0329*
Group Centroids				
Agricultural	-0.6498	-0.4298	-0 0190	-0.1528
Manufacturing	0 5709	0.9739	-0.1554	-0.1042
Manufacturing/Other	1.6149	0.7018	0 9679	0.0858
Agricultural/Other	0.5383	-0 3430	-0.2526	0.0687
NonAg-NonMfg	0.9113	0 1758	0.515	0.5507
No Specialty	-0.0832	0 2227	-0.0954	0.7233

* Indicates the predominant discriminating variable(s) in function.

separate manufacturing/other counties from agriculture counties, as shown by the divergence of the group centroids on the function. The manufacturing and the agriculture/other counties cannot be uniquely distinguished from each other on function I as their group centroids lie close to each other.

The rotated standardized coefficients indicate that the predominant variable in function I relative to all other functions is pURB. This implies that the manufacturing/other specialization counties differ from all other county groups, particularly agriculture counties, by being more urbanized. On a comparative basis, manufacturing/other counties are the most urbanized of all county groups, followed by nonagriculture/nonmanufacturing counties, then manufacturing and agriculture/other counties, with agriculture counties the least urbanized.

The group centroids on function II suggest that it is primarily able to separate manufacturing counties from agriculture and agriculture/other counties. The prominence of the variables INC70 and TAX in function II suggests that manufacturing counties differ from agriculture and agriculture/other counties by having higher median incomes and lower per capita property taxes.

The group centroids in discriminant function III suggest that the function primarily separates manufacturing/other counties from all other counties, notably agriculture/other and manufacturing counties. The standardized coefficients indicate that the predominant variables in function III are POP and ACC. This implies that manufacturing/other

counties differ from all other counties, especially agriculture/other and manufacturing counties, by being more populous and having more interstate highways within their borders. Function III shows that manufacturing activities are not necessarily concentrated in large urbanized population centers, but that the less populous nonmetropolitan communities are also attracting manufacturing activities.

The group centroids on function IV suggest that the separation of counties with no specialized activity and counties with specialization in nonagriculture/nonmanufacturing activities from all other county groups, particularly agriculture and manufacturing counties, is primarily along discriminant function IV. The prominence of the variable RPOP70 in function IV relative to the other functions indicates that no specialty counties and counties with specialization in nonagriculture/nonmanufacturing activities differ from agriculture and manufacturing counties by having a higher proportion of their resident population as potential labor force.

Based on examination of the group centroids and the rotated standardized coefficients across the four discriminant functions (Table 7), the following observations are made on the economic specializations. (1) Counties that specialize in only agriculture production can be characterized as being low-income, non-urban and have relatively high per capita property taxes. Agriculture counties also have relatively smaller labor forces. (2) Manufacturing counties can be regarded as relatively high-income, less populous, less accessible with a smaller labor force. Manufacturing counties also have relatively low per

capita property taxes. (3) Counties with specialization in manufacturing/other economic activities can be characterized as being more metropolitan, i.e., they are highly urbanized, more populous and highly accessible. (4) Counties that specialize in agriculture/other economic activities are relatively less populous and less accessible. (5) Counties with specialization in nonagriculture/ nonmanufacturing activities can be characterized as urbanized with relatively large labor forces in their resident populations. (6) Counties with no specialty can be characterized as non-urbanized with relatively large labor forces in their resident populations.

Classification Results

In this section, the classification results from two prior probability functions used to classify counties into economic specialization categories are presented. The results in Table 8 are based on proportional prior probabilities and those in Table 9 on equal prior probabilities. With proportional priors, Table 8, 63 percent of the observations are correctly classified, while with equal priors, Table 9, 52 percent are correctly classified.[13/] The larger percent correctly classified with the proportional priors distribution is due primarily to the dominance of the agriculture specialization in the sample and the correct classification of 91 percent of the agriculture counties. In addition, more manufacturing counties are correctly classified using the proportional prior. However, the percent correctly classified is higher with the equal prior distribution for the remaining four economic specialization classes.[14/]

TABLE 8: Classification of Counties Based on Locational and Community Characteristics by Economic Specialization (Proportional Probabilities)

Actual Group	No. of Counties	Predicted Group Membership					
		Agricultural	Manufacturing	Manufacturing/ Other	Agricultural/ Other	NonAg- NonMfg	No Specialty
Agricultural	535 (50.81%)	487 (91 0%)	30 (5 6%)	0 (0 0%)	9 (1 7%)	4 (0 7%)	5 (0.9%)
Manufacturing	194 (18 42%)	64 (33.0%)	118 (60.8%)	6 (3 1%)	5 (2 6%)	0 (0.0%)	1 (0.5%)
Manufacturing/Other	74 (7 02%)	13 (17.6%)	29 (39 2%)	23 (31.1%)	4 (5 4%)	5 (6 8%)	0 (0 0%)
Agricultural/Other	112 (10.64%)	65 (58 0%)	16 (14 3%)	1 (0 9%)	24 (21 4%)	4 (3 6%)	2 (1.8%)
NonAg-NonMfg	69 (6 55%)	26 (37.7%)	17 (24.6%)	9 (13 0%)	10 (14 5%)	6 (8 7%)	1 (1.4%)
No Specialty	60 (6 55%)	46 (66 7%)	11 (15.9%)	1 (1 4%)	3 (4 3%)	5 (7 2%)	3 (4.3%)
Total	1053 (100 00%)	701 (66 6%)	221 (21.0%)	40 (3 8%)	55 (5 2%)	24 (2 3%)	12 (1.1%)

Percent of "grouped" counties correctly classified = 62 77%

TABLE 9: Classification of Counties Based on Locational and Community Characteristics by Economic Specialization (Equal Probabilities)

Actual Group	No. of Counties	Predicted Group Membership					
		Agricultural	Manufacturing	Manufacturing/ Other	Agricultural/ Other	NonAg-NonMfg	No Specialty
Agricultural	535 (50.81%)	330 (61.7%)	47 (8.8%)	0 (0.0%)	97 (18.1%)	12 (2.2%)	49 (9.2%)
Manufacturing	194 (18.42%)	11 (5.7%)	103 (53.1%)	24 (12.4%)	20 (0.3%)	12 (6.2%)	24 (12.4%)
Manufacturing/Other	74 (7.2%)	0 (0.0%)	16 (21.6%)	30 (40.5%)	8 (10.8%)	15 (20.3%)	5 (6.8%)
Agricultural/Other	112 (10.64%)	21 (18.8%)	8 (7.1%)	2 (1.8%)	51 (45 5%)	16 (14.3%)	14 (12.5%)
NonAg-NonMfg	69 (6.55%)	6 (8.7%)	11 (15.9%)	12 (17.4%)	15 (21 7%)	17 (24.6%)	8 (11.6%)
No Specialty	69 (6.55%)	22 (31.9%)	10 (14.5%)	2 (2.9%)	6 (8.7%)	10 (14.5%)	19 (27.5%)
Total	1053 (100.00%)	390 (37 0%)	195 (18.5%)	70 (6.6%)	197 (18 7%)	82 (7.8%)	119 (11.3%)

Percent of "grouped" counties correctly classified = 52.23%.

Concluding Remarks

Through the force of large numbers, it is possible to classify correctly a high proportion of agriculture and manufacturing counties. However, the discriminant model developed in this study is not sensitive enough to correctly classify counties which have more complex employment structures. To improve the ability to classify counties, considerable thought needs to be devoted to improvement of the classification procedure. There is too much overlap across classes in the definitions used in this study.

From these results, several generalizations seem warranted. First, manufacturing is distributed across a wide array of metropolitan and nonmetropolitan counties. In metropolitan counties, manufacturing is accompanied by other specialties. Second, agriculture is found in nonmetropolitan counties as expected, but is a dominant source of employment in relatively few counties. Finally, the nonagriculture, nonmanufacturing specialties tend to be found in relatively urbanized counties with larger working age populations. However, a number of nonmetropolitan counties also participate in these specializations along with agriculture.

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FOOTNOTES

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1/ Alternatively, the sectoral income distribution could have been used to classify counties. See Bluestone [2] for the use of income data in another context.

2/ There are 12 states in the North Central Region: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

3/ The unit of analysis is the county, and the term county is used throughout.

4/ While use of the location quotient to define economic specialization is arbitrary, it is probably the most commonly used benchmark criteria in regional economics. The use of any other criteria would have been equally arbitrary. An alternative criteria (see below) was used to examine the sensitivity of the model to specification of economic specialization.

5/ The property tax rate would have been a preferable variable because of the confounding effect of taxable property on per capita property taxes. However, the derivation of a property tax rate variable would have required significant additional data collection costs.

6/ The documented and edited employment and income data for the North Central Region was provided by Wilbur Maki of the Department of Agricultural and Applied Economics, University of Minnesota.

7/ Under the alternative classification procedure in note 5, the percentages were Agriculture (3); Manufacturing (28); Trade and Construction (25); Mining, Transportation, Communications and Utilities (8); Finance, Insurance, Real Estate and Services (17); and Government (17). The totals do not sum to 100 because of the unclassified group.

8/ Because there is an unclassified group in each county, it is possible for a county to have all location quotients less than one for the classified industries.

9/ The major difference for the alternative classification procedure (see notes 5 and 7) was that the multiple industry classifications were reduced. For example, the number of agriculture/manufacturing counties decreased from 79 in Table 3 to 4 under the alternative criteria.

10/ When within-group variances are unequal, quadratic discriminant functions may be more appropriate. Given the exploratory nature of

this study, only linear functions were estimated. For further details, see Eisenbeis and Avery [4].

11/ The major data source was the computer tape [22] obtained through the assistance of Herman Bluestone and Peggy Ross, see also [14]. Other sources of data were [13] and [20].

12/ The discriminant functions are the solutions, a, of the matrix equation $(B - \lambda W) = 0$, where B and W are the between and within groups dispersion matrices. This matrix equation is derived by maximizing the ratio of the between group sum of squares (a'Ba) to the within group sum of squares (a'Wa) on the discriminant function represented by the eigenvalues g and their associated eigenvectors a. For more details see [3, pp. 117-118].

13/ To obtain unbiased classification results, the sample was randomly split into two groups: two-thirds were used to estimate the discriminate functions and one-third were classified. The percent correctly classified was 65.9 for a proportional prior and 53.3 for an equal prior.

14/ The discriminant model was also estimated for the East North Central and the West North Central subregions and the results were generally similar.